510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY AND INSTRUMENT COMBINATION TEMPLATE

A. 510(k) Number:
k070239

B. Purpose for Submission:
New Device

C. Measurand:
Whole blood glucose

D. Type of Test:
Quantitative, amperometric (glucose oxidase)

E. Applicant:
Exir Pharmaceutical Company

F. Proprietary and Established Names:
Maximed Exichek TD 4224 Blood Glucose Monitoring System

G. Regulatory Information:

1. Regulation section:
   21 CFR § 862.1345, Glucose Test System

2. Classification:
   Class II

3. Product code:
   NBW - System, Test, Blood Glucose, Over The Counter
   CGA - Glucose Oxidase, Glucose
   JJX - Quality control material (assayed and unassayed).

4. Panel:
   75 (Clinical Chemistry)

H. Intended Use:

1. Intended use(s):
   See Indications for use below.

2. Indication(s) for use:
   The Maximed Exichek TD 4224 Blood Glucose Monitoring System is intended for use in the quantitative measurement of glucose in fresh capillary whole blood from the finger and from the following alternative sites: the palm, the forearm, the upper-arm, the calf and the thigh. It is intended for use by healthcare professionals and people with diabetes mellitus at home as an aid in monitoring the effectiveness of diabetes control program. It is not intended for the diagnosis of or screening for diabetes mellitus, and is not intended for use on neonates.

The alternative site testing in the Maximed Exichek TD 4224 Blood Glucose Monitoring System can be used only during steady-state blood glucose conditions.

3. Special conditions for use statement(s):
   For Over-the-Counter use.
   The alternative site testing in the Maximed Exichek TD 4224 Blood Glucose Monitoring System can be used only during steady-state blood glucose conditions.
   Alternative site testing (AST) should ONLY be used in the following intervals:
   - In a pre-meal or fasting state (more than 2 hours since the last meal)
   - Two hours or more after taking insulin
   - Two hours or more after exercise

4. Special instrument requirements:
   Maximed Exichek TD-4224 Blood Glucose Meter

I. Device Description:

The Maximed Exichek TD-4224 Blood Glucose Monitoring System consists of Maximed Exichek TD-4224 blood glucose meter, Maximed Exichek TD-4224 blood glucose test strips (glucose oxidase), Exichek control solutions (low medium and high levels), lancing device and lancets.

J. Substantial Equivalence Information:

1. Predicate device name(s):
   Clever Chek TD-4223 Blood Glucose Monitoring System

2. Predicate 510(k) number(s):
   k063212

3. Comparison with predicate:

Similarities

Item	Device	Predicate
Detection Method	Amperometry	Amperometry
Enzyme	Glucose Oxidase	Glucose Oxidase
Test Range	20 – 600 mg/dL	20 – 600 mg/dL
Sample Volume (µl)	0.7 µl	0.7 µl
Temperature Range	50-104°F, 10-40°C	50-104°F, 10-40°C
Humidity Range	Below 85%	Below 85%
Warranty (meter)	5 years	5 years
Strip Vial Open Use Time	90 days	90 days
Coding	Code strip	Code strip
Memory Capability	450 measurements	450 measurements
Power	Two 1.5 AA Alkaline batteries	Two 1.5 AA Alkaline batteries

Differences

Item	Device	Predicate
Size (mm)	87x19x45	94x20x48
Weight (g)	72.64	79.22

K. Standard/Guidance Document Referenced (if applicable):

- CLSI EP5-A2: Evaluation of Precision Performance of Quantitative Measurement Methods; Second Edition
- CLSI EP6-A: Evaluation of the Linearity of Quantitative Measurement Procedures: A Statistical Approach; Approved Guideline
- CLSI EP7-A2: Interference Testing in Clinical Chemistry; Approved Guideline-Second Edition
- CLSI EP9-A2: Method Comparison and Bias Estimation Using Patient Samples; Approved Guideline – Second Edition
- ISO 15197: In vitro diagnostic test systems - Requirements for blood-glucose monitoring systems for self-testing in managing diabetes mellitus
- ISO 14971: Medical Devices – Application of risk management to medical devices

L. Test Principle:

Once a whole blood sample is applied to the sample chamber of the test strip, the process of glucose measurement commences. Glucose measurement is based on electrical potential caused by the reaction of glucose with the reagents contained on the strip's electrodes. The glucose in the sample is oxidized by the enzyme glucose oxidase, producing gluconic acid. The electrical current resulting from this enzymatic reaction is measured and converted to glucose concentration by the meter. The magnitude of the current is proportional to the concentration of glucose in the sample.

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

a. Precision/Reproducibility:

The sponsor evaluated within-day precision of the device using pooled whole blood samples spiked with five different glucose concentrations, three different reagent lots, and 10 different TD-4224 glucose meters. Each combination of multivariate factors was evaluated using 10 measurements. Day-to-day precision was evaluated using three glucose control solutions with concentration levels, low (61-93 mg/dL), normal (108-162 mg/dL), and high (260-390 mg/dL). The day-to-day precision was evaluated over a ten-day period using three different reagent lots and ten TD-4224 glucose meters. The summary of test results are presented below.

Within-day precision

Sample level (mg/dL)	N	Mean (mg/dL)	SD (mg/dL)	CV (%)
30-50	100	40.1	1.7	4.22
51-110	100	89.0	2.9	3.25
111-150	100	125.3	3.3	2.67
151-250	100	200.6	6.7	3.36
251-400	100	346.9	11.5	3.31

Day-to-day precision

Control Samples	N	Mean (mg/dL)	SD (mg/dL)	CV (%)
Low	100	76	1.88	2.48
Medium	100	128.8	3.74	2.91
High	100	307.7	8.62	2.80

b. Linearity/assay reportable range:

The sponsor used nine spiked whole blood samples in the range (20-600 mg/dL) as reference values and compared with the values generated from YSI2300 analyzer. A regression analysis showed linearity of Maximed Exichek TD-4224 blood glucose monitoring system with correlation coefficient (r) of 0.9991 with regression equation of y = 0.9959X + 4.4273. The sponsor verified accuracy of the device over the reportable range (20 – 600 mg/dL) against a standard detection method (YSI-2300; see Method Comparison below).

c. Traceability, Stability, Expected values (controls, calibrators, or methods):

The calibration is traceable to the YSI instrument. The values for the control materials are verified by testing the material on multi meters over 30 days to obtain the mean and standard deviation. The ranges are assigned based upon the ISO criteria.

The sponsor provided data to confirm the stability of both strips and control solutions for 90-day period recommended in the package insert. The sponsor conducted studies to evaluate the in-use stability of the TD-4224 glucose monitoring system at the assigned temperature range of 50^{o}F-104^{o}F (10^{o}C-40^{o}C). Using control solutions at low, medium and high concentration, tested at 50^{o}F and 104^{o}F compared with room temperature, results showed <2% CV for all glucose concentrations and met the acceptability criterion (<5% CV).

Using control solutions, the sponsor also conducted studies to evaluate the meter reliability at mechanical resistance to drop and vibration as well as the effect of temperature and relative humidity on the glucose meter. TD-4224 met the acceptability criterion of <5% CV at each variant condition.

d. Detection limit:

The detection limit is 20 mg/dL. See the linearity study.

e. Analytical specificity:

The sponsor tested the following exogenous and endogenous substances for interference. Based on a criterion of a mean glucose difference of ± 10% of the glucose values obtained in the absence of interfering substances, the following conclusions were drawn with regard to interfering substances:

Substance	Test Concentration (mg/dL)	No Interference (mg/dL)	
		Low Glucose level (75-85)	High Glucose level (300)
Acetaminophen	20	5	5
Ascorbic Acid	3	3*	3*
L-Dopa	12	3	3
Dopamine	13	2	2
Methyl-Dopa	2.5	0.5	0.75
Tolbutamide	200	200*	200*
Uric acid	20	5	20*
Triglycerides	2000	2000*	2000*

* No interference up to test concentration

The sponsor evaluated the effect of hematocrit levels 20 – 60% on whole blood samples spiked with glucose values (6 levels) ranging from approximately 23 to 486 mg/dL. The values generated were compared with the glucose values from YSI-2300 analyzer. The results indicated below showed that bias introduced at hematocrit levels between 20% and 60% were within ± 15%.

Hematocrit %	Slope and Y-intercept	R
21	y= 1.090x+0.128	0.998
30	y=0.991x+3.096	0.998
37	y=0.967x+5.464	0.996
46	y=1.015x-1.354	1.000
61	y=0.984x-0.616	0.999

An altitude study was performed with whole blood samples from 20 volunteers and 3 control solutions at low, medium and high concentrations. All the controls met the sponsors acceptability criterion of CV<5% for the control solutions measured at sea level and at an altitude of 10,744 feet. Altitude differences within individuals met the acceptability criterion of ±15mg/dL deviation for glucose concentration of <75 mg/dL and ±20% deviation for glucose concentration of ≥75 mg/dL.

f. Assay cut-off:

Not Applicable.

2. Comparison studies:

a. Method comparison with predicate device:

The sponsor demonstrated that the Maximed Exichek TD-4224 Blood Glucose Monitoring System for finger stick is equivalent to a standard reference method (YSI-2300). Samples from 136 volunteers with glucose concentrations distributed over the claimed range of 20 – 600 mg/dL were evaluated at three different laboratory sites. Percent distribution of the

samples corresponding to the glucose concentration ranged as follows: 20-50 mg/dL – 5%; 51-110 mg/dL – 31%; 111-150 mg/dL – 14%; 151-250 mg/dL – 40%; 251- 400 mg/dL – 18%; and 401-600 mg/dL – 6%. Based on data analysis, the device met the minimum system accuracy requirement established according to the ISO 15197 guidelines as follows:

Difference distribution for glucose concentrations < 75 mg/dL

Within ± 5 mg/dL	Within ± 10 mg/dL	Within ± 15 mg/dL
17/20 (85%)	19/20 (95%)	20/20 (100%)

Difference distribution for glucose concentrations ≥75 mg/dL

Within ± 10%	Within ± 15%	Within ± 20%
110/116 (95%)	114/116 (98%)	116/116 (100%)

In comparison with YSI-2300, all three laboratory sites showed the following regression equations.

TD-4224 vs. YSI-2300 reference method

Site	N	Slope and Y-intercept	R
1	46	y= 0.979x+0.795	0.994
2	45	y=0.990x-1.346	0.990
3	45	y=0.982x+2.486	0.992
Total	136	y=0.984x-0.616	0.992

The sponsor also conducted a consumer study to evaluate the accuracy of glucose measurement between the lay-user and the healthcare professionals. Using 131 volunteer samples (Glucose range: 39 – 301 mg/dL) at three distribution sites, they showed the device meets their acceptability criteria as well as ISO-15197 criteria with 96% of individual differences within ±15mg/dL deviation for glucose concentrations of <75 mg/dL and ±20% deviation for glucose concentrations of ≥75 mg/dL.

The sponsor conducted the alternative site testing (AST) using the palm, the forearm, the upper arm, the calf, and the thigh in comparison to data obtained using finger. Regression results are shown below and the percentage of results meeting ISO-15197 acceptance criteria for accuracy.

Comparison	N	Range (mg/dL)	Slope and Y-intercept	R
Palm vs. finger	100	45-421	y= 0.982x+1.713	0.983
Forearm vs. finger	100	49-436	y=0.989x-0.747	0.985
Upper arm vs. finger	100	43-435	y=0.995x-1.044	0.977
Calf vs. finger	100	44-419	y=0.956x+2.756	0.973
Thigh vs. finger	100	50-422	y=0.981x-3.827	0.976

AST site	Percentage of results within ± 15 mg/dL for glucose concentrations < 75 mg/dL and within ± 20% for glucose concentrations ≥ 75 mg/dL
Palm	96/100 (96%)
Forearm	97/100 (97%)
Upper arm	97/100 (97%)
Calf	95/100 (95%)
Thigh	96/100 (96%)

b. Matrix comparison:
Not applicable

3. Clinical studies:

a. Clinical Sensitivity:
Not Applicable.

b. Clinical specificity:
Not Applicable.

c. Other clinical supportive data (when a. and b. are not applicable):

4. Clinical cut-off:
Not Applicable.

5. Expected values/Reference range:
The sponsor included the following expected values in their strip labeling:

Status	Plasma glucose range for people without diabetes
Before meals	70-110 mg/dL
2 hours after meals	<120 mg/dL

Source: American Diabetic Association Clinical Practice Recommendations 2003

N. Instrument Name:
Maximed Exichek TD-4224 Blood Glucose Monitoring System

O. System Descriptions:

1. Modes of Operation:
Each test strip is single use and must be replaced with a new strip for each additional reading.

2. Software:
FDA reviewed the applicant's Hazard Analysis and software development processes.
Yes__x__ No _____

Documentation was provided at a moderate level of concern.

3. Specimen Identification:
   There is no sample identification function with this device. Samples are applied directly to the test strip as they are collected.

4. Specimen Sampling and Handling:
   This device is intended to be used with capillary whole blood from the finger, the palm, the forearm, the upper-arm, the calf, and the thigh only. Since the whole blood sample is applied directly to the test strip, there are no special handling or storage issues.

5. Calibration:
   A code strip is provided with each batch of test strips to calibrate the meter for that batch.
   No further calibrations are required of the user.

6. Quality Control:
   The sponsor is providing low, medium and high glucose control solutions with this device. When a test strip is inserted into the meter, the control mode can be activated. This prevents control results from being stored in the internal memory. An acceptable range for each control level is printed on the test strip vial label. The user is referred to the troubleshooting section of the owner's manual if control results fall outside these ranges.

P. Other Supportive Instrument Performance Characteristics Data Not Covered In The "Performance Characteristics" Section above:

Q. Proposed Labeling:

The labeling is sufficient and it satisfies the requirements of 21 CFR Part 809.10.

R. Conclusion:

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.